

IN THE CLAIMS:

Please amend claims 1, 7, and 17, and add new claim 19 as follows:

1. (Currently Amended) A magnetic sensor including a ferromagnetic tunnel junction, comprising:

a free layer, a magnetic direction of which freely rotates; and

a barrier layer formed on the free layer,

the barrier layer including a first region and a second region around the first region, and a thickness of the barrier layer in the second region being greater than a thickness of the barrier layer in the first region, both of said first and second regions being on the free layer in a layer-stacking direction,

a region of the free layer corresponding to the first region functioning as a sensor portion for sensing an external magnetic field.

2. (Original) A magnetic sensor according to claim 1, wherein the barrier layer is formed by oxidizing the surface of a metal.

3. (Original) A magnetic sensor according to claim 1 or 2, further comprising:

a fixed layer formed on the barrier layer; and

a antiferromagnetic layer formed on the fixed layer and fixing a magnetic direction of the fixed layer.

4. (Original) A magnetic sensor according to claim 3, wherein the free layer in a region where the fixed layer is not formed is bent away from the fixed layer.

5. (Previously Amended) A magnetic head comprising the magnetic sensor according to claim 1 or 2.

6. (Previously Amended) A magnetic encoder comprising the magnetic sensor according to claim 1 or 2.

7. (Currently Amended) A magnetic head, comprising:  
a ferromagnetic tunnel junction element including a free layer, a magnetic direction of which freely rotates, and a fixed layer which is opposed to one surface of the free layer through a barrier layer, a magnetic direction of the fixed layer being fixed by an antiferromagnetic layer which is adjacent thereto; and

shield layers of high permeability formed at both sides of the ferromagnetic tunnel junction element, the shield layers being spaced from the ferromagnetic tunnel junction element, respectively,

wherein the fixed layer extends in a first direction generally parallel to the antiferromagnetic layer, and

wherein an end portion of the free layer being extended from and projected extends and projects from the ferromagnetic tunnel junction element toward one of the shield layers in a second direction different from the first direction, and the end portion of the free layer being connected connecting to the one of the shield layers.

8. (Original) A magnetic head according to claim 7, wherein the free layer is connected to the member of high permeability in a region spaced from a signal detection surface.

9. (Original) A magnetic head according to claim 7 or 8, wherein the free layer is connected smoothly to the member of high permeability, neighboring the same.

10. (Previously Amended) A magnetic head according to claim 7 or 8, wherein the member of high permeability is a shield layer formed, spaced from the ferromagnetic tunnel junction element.

11. (Previously Amended) A magnetic head according to claim 7 or 8, wherein the thickness of the barrier layer near the edge of the fixed layer is larger than a thickness of the barrier layer near a central part of the fixed layer.

12. (Previously Amended) A magnetic head according to claim 7 or 8, wherein the free layer is formed wider in a region spaced from the signal detection surface.

13. (Previously Amended) A magnetic head according to claim 7 or 8, wherein the fixed layer is not exposed to the signal detection surface.

14. (Previously Amended) A magnetic head according to claim 7 or 8, wherein the member of high permeability is grounded.

15. (Previously Amended) A magnetic head according to claim 7 or 8, wherein the free layer in a region which is not opposed to the fixed layer is bent away from the fixed layer.

16. (Previously Amended) A magnetic head according to claim 7 or 8, wherein the ferromagnetic tunnel junction element further includes another fixed layer which is opposed to the free layer through another barrier layer formed on the other surface of the free layer, a magnetic direction of said another fixed layer being fixed by another antiferromagnetic layer which is adjacent thereto.

17. (Currently Amended) A hard disk device comprising the magnetic head according to claim 5-~~6~~-7.

18. (Original) A disk array device comprising a plurality of the hard disk devices according to claim 17.

19. (New) A hard disk device comprising the magnetic head according to claim 7.